

VecLI : Vector-based Landscape Index Calculation and Analysis

Version 1.0



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HPSCIL

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1. Product Introduction

1.1. VecLI Product

VecLI is a system for calculating and evaluating landscape indices of land-parcels in vector-based data format, which could be used to calculate landscape indices based on real plots and analyze the landscape similarity between different cities.

1.2. Target Users

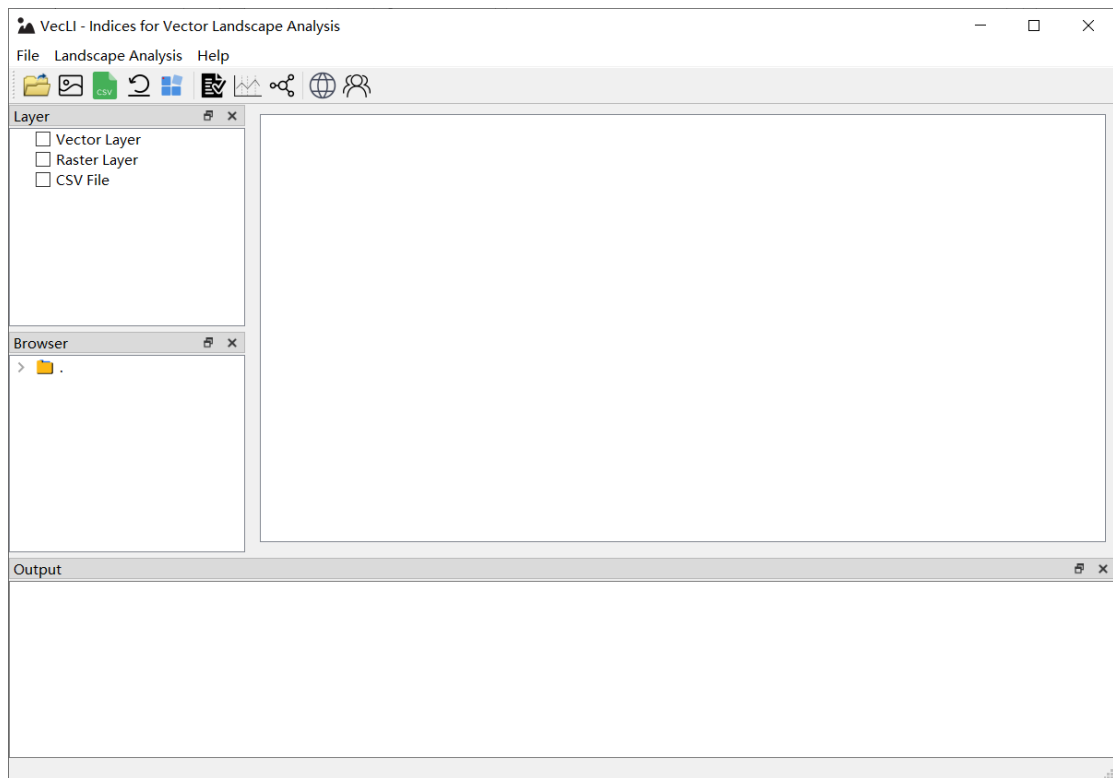
Researchers and urban planners in the field of urban planning.

1.3. Installation

Please **unzip** the software package to the full English file path. **Double-click** “setup.exe” and follow the prompts to install the software. After the installation is complete, you will get the following folder.

Double-click “VecLI.exe” to open the VecLI project.

1.4. User Interface

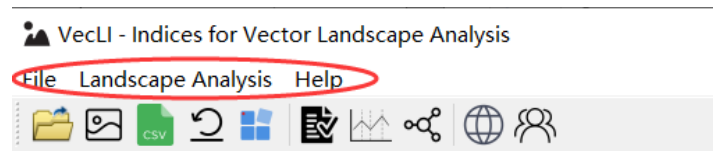


1.5. Software Control Panel Description

1.5.1. Menu Bar

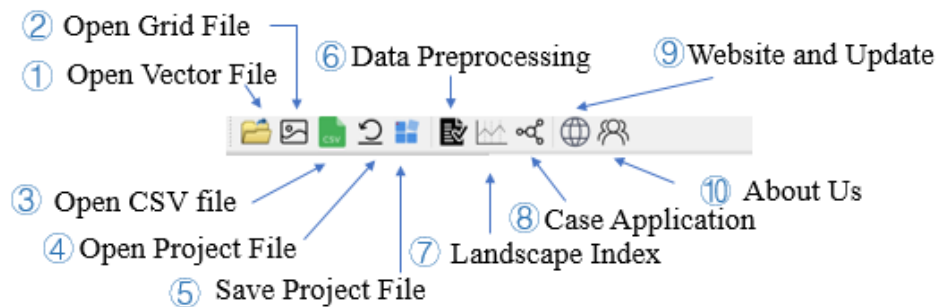
The menu bar of VecLI includes three parts:

“File”, “Landscape Analysis” and “Help”.



1.5.2. Tool Bar

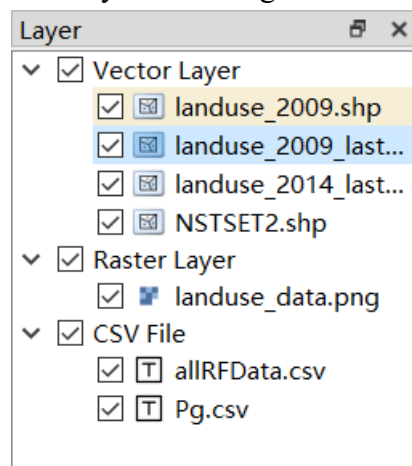
The tool bar of VecLI includes 9 parts:



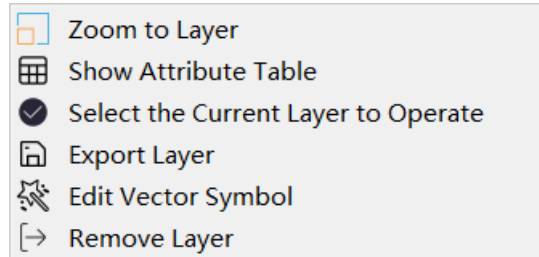
1.5.3. Data Management Panel

A brand-new IO, operational and roaming interface for operating the spatial data (raster and vector data) is designed. Basic functions of GIS such as attribute edit, layer symbolization, zoom in and out operation, etc. are included.

Data imported into VecLI will be displayed and grouped by "Vector Layer", "Raster Layer" and "CSV File" layer according to its file format.。

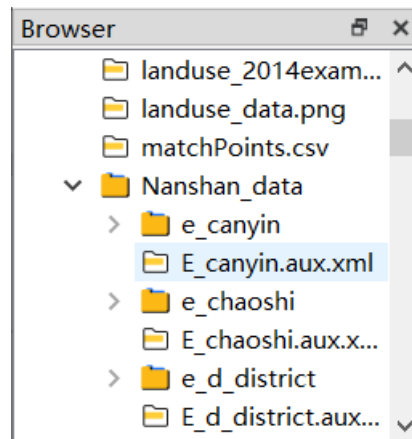


To determine a specific GIS operation, Right-Click the selected data and a GIS operation widget will pop up on hand. Available GIS operations include “Zoom to Layer”, “Show Attribute Table”, “Select the Current Layer to Operate”, “Export Layer”, “Edit Vector Symbol”, and “Remove Layer”.



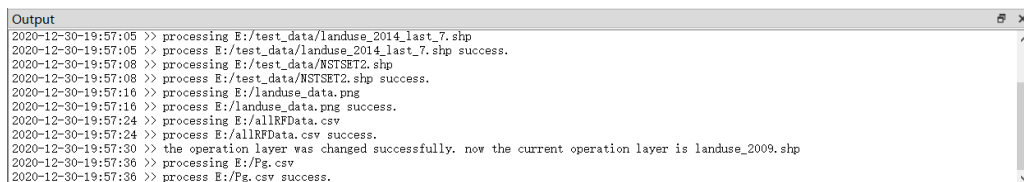
1.5.4. Current Directory Browser Panel

This panel provides directory browser to search for, find, view, and open VecLI related directories and files.



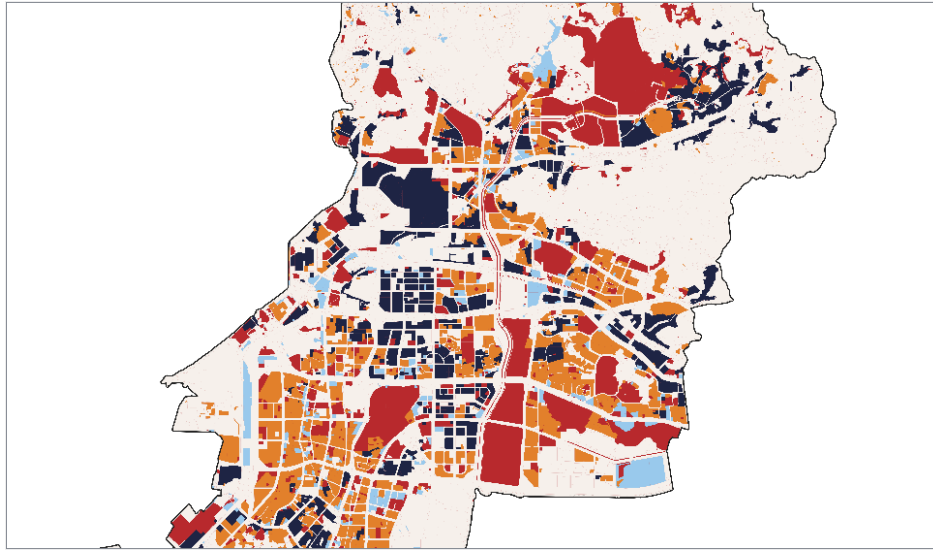
1.5.5. Log Output Panel

VecLI provides a real-time output for monitoring and generates log files for the whole computation process of vector-based landscape index.



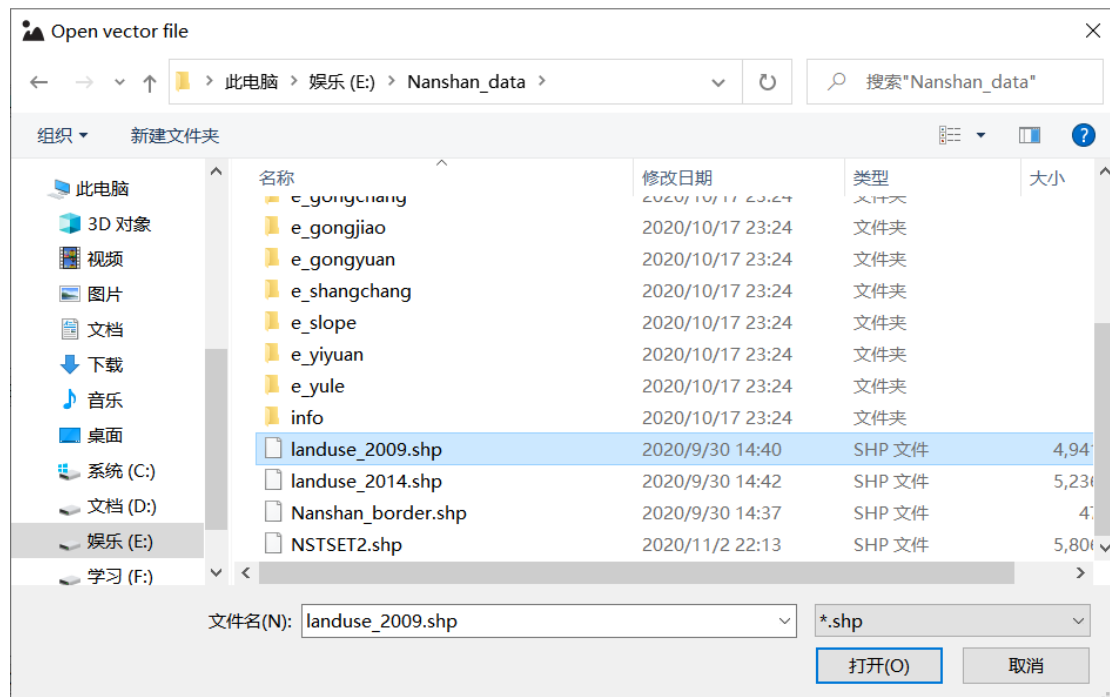
1.5.6. Data Visualization Panel

The panel supports roaming and display for vector and raster files imported into the system.



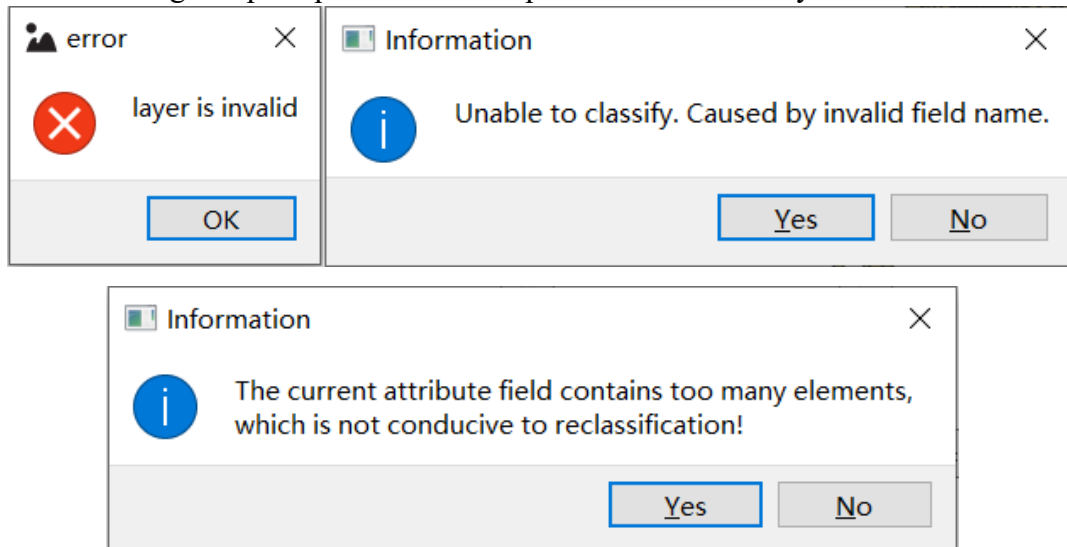
1.5.7. Directory Selection Dialog Box

This module provides a UI for directory and file selection, which is used to *specify* the location for importing, saving and exporting data files.



1.5.8. Exception Prompt Dialog Box


This dialog box prompts the error and provides the necessary information to debug.

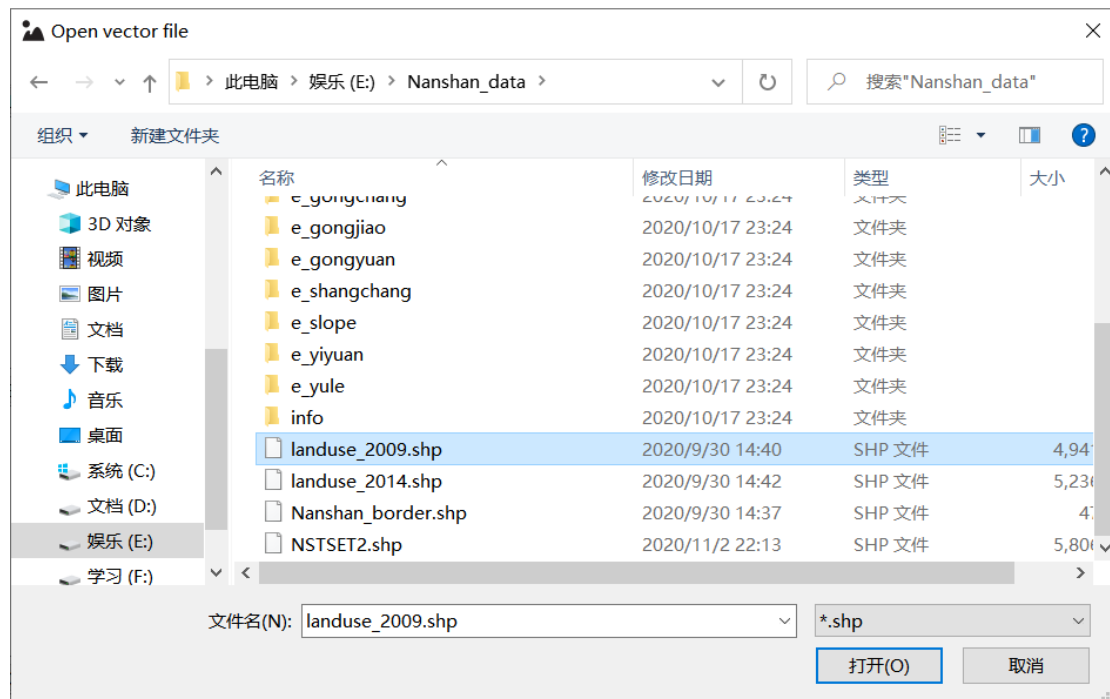



2. Data Display Function

2.1. Basic Function

2.1.1. Import Files

Click the “Open Vector File” button  in the toolbar, it will automatically jump to the Directory Selection Dialog Box for vector file selection.

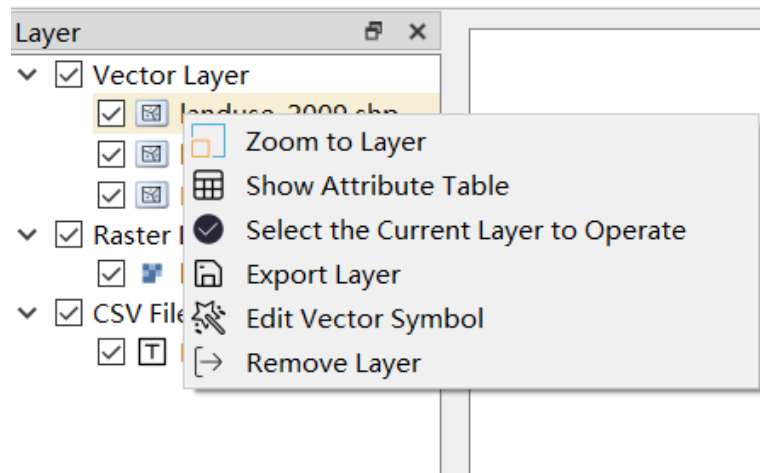


Click the “Open Grid File” button  in the toolbar, it will automatically jump to the Directory Selection Dialog Box for raster file selection.

Click the “Open CSV File” button  in the toolbar, it will automatically jump to the Directory Selection Dialog Box for CSV file selection.

2.1.2. Basic GIS Operations

Right-click the selected data layer, it will pop up a GIS operation widget, as shown in the figure below:



2.1.3. Zoom to Layer

Click the “Zoom to Layer” button to display the data layer in a full view for either a vector or raster data layer.

2.1.4. Show Attribute Table

Click the “Open Attribute Table” button to show the attribute table of a selected CSV file.

Attribute *edit* is allowed for each entry, as shown in the figure below:

	OBJECTID	BSM	YSYM	TBYBH	TBBH	DLBM	DLMC	QSZX	QSDWDM	QSDWMC	ZLDWDM	ZLDWMC	GDL
1	33757	138.00000000	2001010100	建设	270	102	公路用地	10	440304004001	梅林街道	440304004001	梅林街道	
2	38355	43071.00000000	2001010100	建设	5610	201	城市	10	440306007001	石岩街道	440306007001	石岩街道	
3	38356	43000.00000000	2001010100	建设	5604	201	城市	10	440306007001	石岩街道	440306007001	石岩街道	
4	40054	1364.00000000	2001010100	建设	535	201	城市	10	440304004001	梅林街道	440304004001	梅林街道	
5	40055	1372.00000000	2001010100	建设	536	201	城市	10	440304004001	梅林街道	440304004001	梅林街道	
6	39645	108.00000000	2001010100	农用	249	031	有林地	10	440304004001	梅林街道	440304004001	梅林街道	
7	39315	4044.00000000	2001010100	建设	658	201	城市	10	440304006001	沙头街道	440304006001	沙头街道	
8	40488	1800.00000000	2001010100	建设	398	201	城市	10	440304007001	香蜜湖街道	440304007001	香蜜湖街道	
9	41149	3760.00000000	2001010100	建设	723	201	城市	10	440304006001	沙头街道	440304006001	沙头街道	
10	41654	3793.00000000	2001010100	建设	77	201	城市	10	440304006001	沙头街道	440304006001	沙头街道	
11	41105	4042.00000000	2001010100	农用	72	033	其他林地	10	440304006001	沙头街道	440304006001	沙头街道	
12	41889	3243.00000000	2001010100	建设	722	201	城市	10	440304006001	沙头街道	440304006001	沙头街道	
13	42798	46609.00000000	2001010100	建设	184	201	城市	10	440306010001	新安街道	440306010001	新安街道	
14	43313	451.00000000	2001010100	农用	393	031	有林地	10	440304004001	梅林街道	440304004001	梅林街道	
15	43468	48511.00000000	2001010100	建设	957	201	城市	10	440306010001	新安街道	440306010001	新安街道	
16	43318	1872.00000000	2001010100	农用	176	033	其他林地	10	440304007001	香蜜湖街道	440304007001	香蜜湖街道	
17	43750	45385.00000000	2001010100	建设	5810	201	城市	10	440306007001	石岩街道	440306007001	石岩街道	
18	42472	4046.00000000	2001010100	未利	212	115	沿海滩涂	10	440304006001	沙头街道	440304006001	沙头街道	
19	42473	4104.00000000	2001010100	未利	213	115	沿海滩涂	10	440304006001	沙头街道	440304006001	沙头街道	
20	42555	44837.00000000	2001010100	建设	5746	201	城市	10	440306007001	石岩街道	440306007001	石岩街道	

2.1.5. Select the Current Layer to Operate

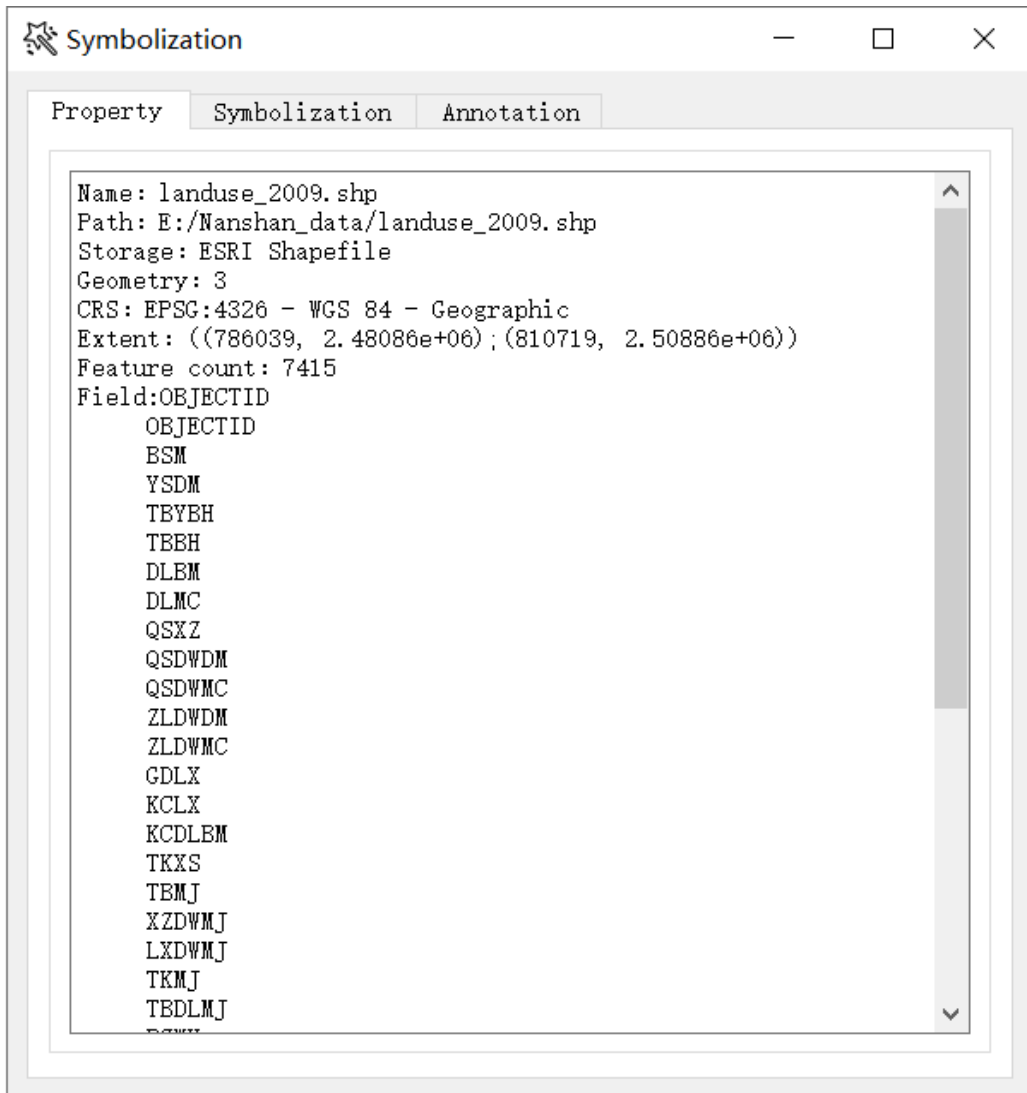
Click the “Select the Current Layer to Operate” button, it will enable the selected layer for the vector symbolization function.

2.1.6. Edit Vector Symbol

Click the “Edit Vector Symbol” button to enable the file property option, symbolization option and Annotation option.

2.1.6.1. Property

Select “Property” to view the property information for the current open vector file:

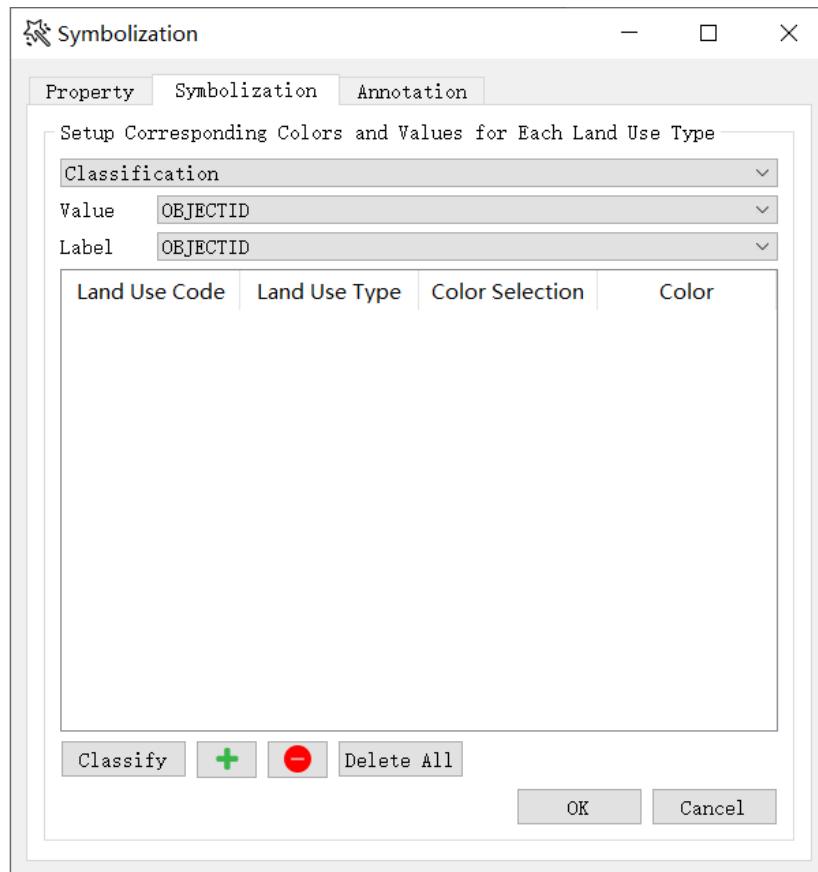


The property sheet will show contents such as Name, Path, Storage (File type), Geometry, CRS (coordinate reference system), Extent, Feature count (number of

features), and Field information of the current layer for users to *consult*.

2.1.6.2.Symbolization

Select “Symbolization” to carry out symbolization operation. Users can set a classified display for different attribute fields:



For the “Classification” drop-down box, users can *select* a specific Symbolization Method for the currently operating data layer.

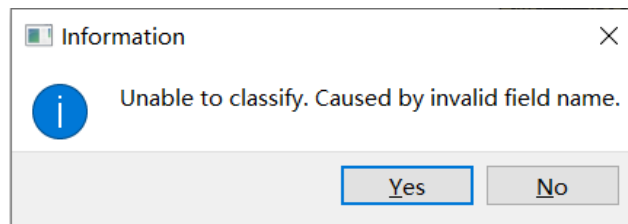
For the “Value” drop-down box, users can *select* a specific field name that needs classification.

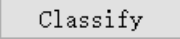
For the “Label” drop-down box, users can *select* a specific field name that labels the category.

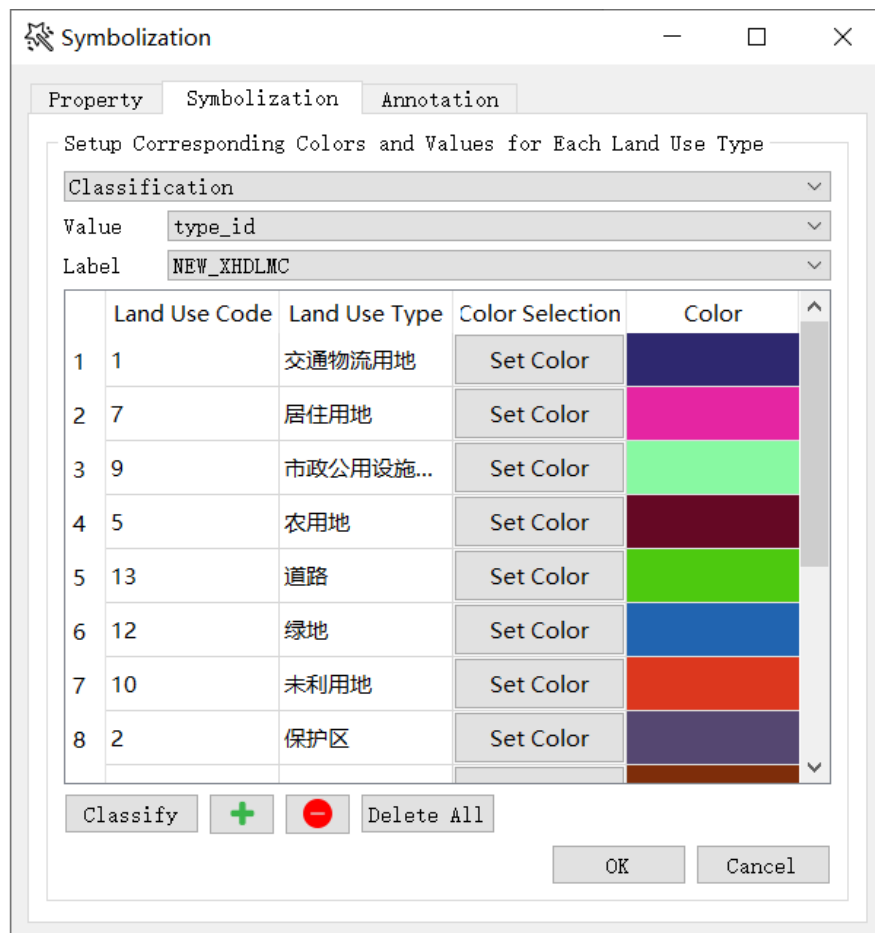
Setup Corresponding Colors and Values for Each Land Use Type


Classification	▼
Value	OBJECTID ▼
Label	OBJECTID ▼

Note: if a non-numeric field is selected in the “Value” drop-down box, Exception Prompt Dialog Box will pop up and ask the user to *re-select* a valid field:



Click the “Classify”  button to conduct Vector Symbolization and initialize classification automatically. A sample of classification result is shown as below:



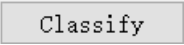
Click the “Add a Class”  button, it will automatically add a new category, as shown below:

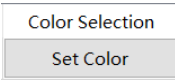


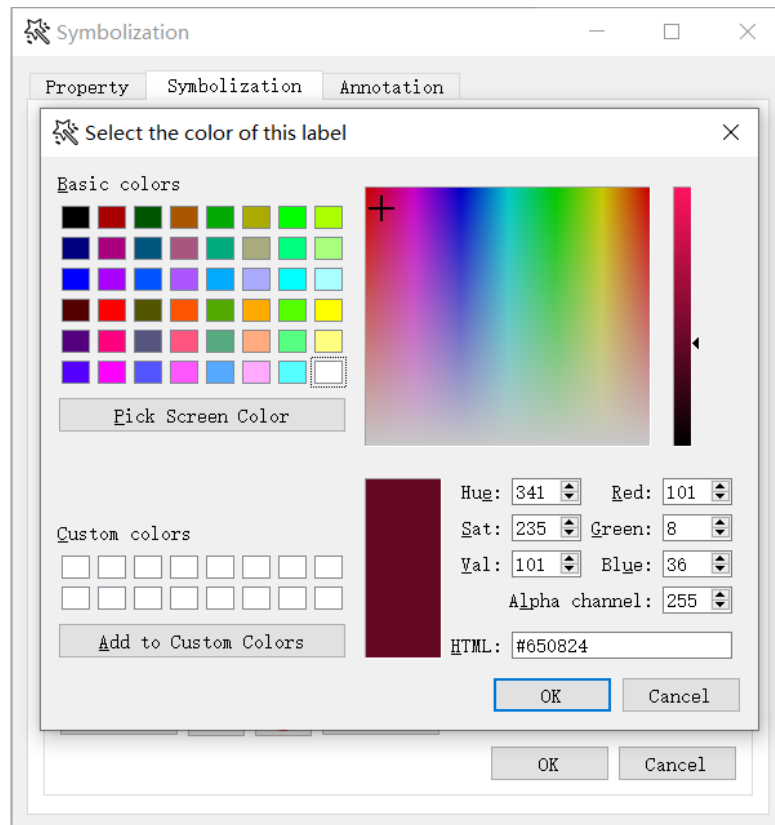
Click the “Delete a Class”  button, it will delete the current selected category, as shown below:

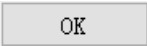


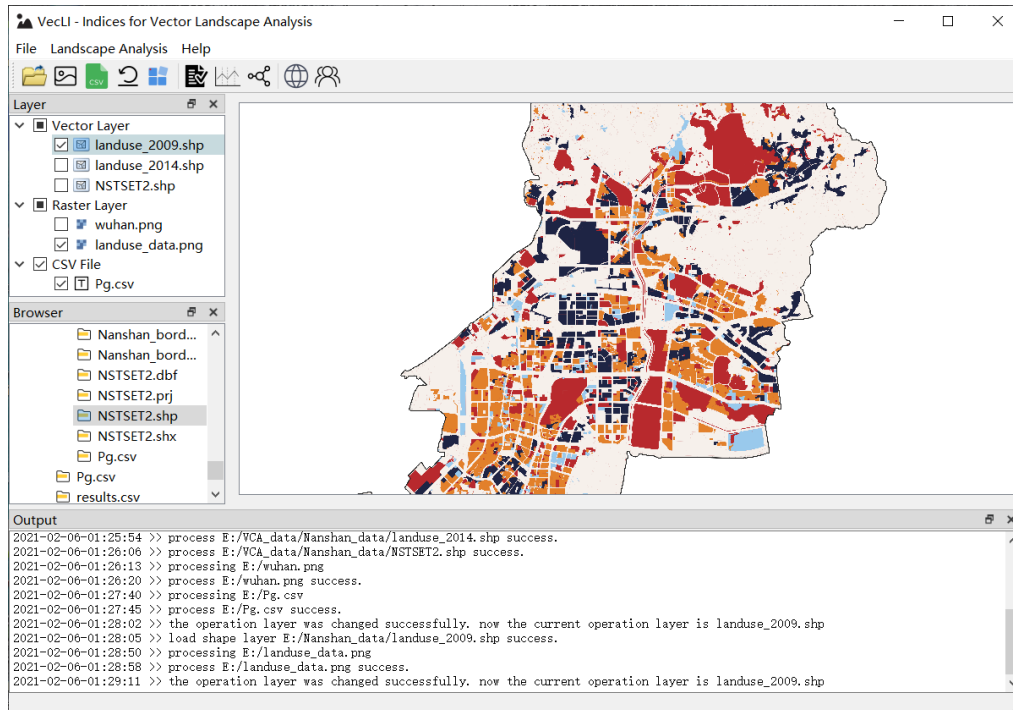
Click the “Delete All ” button, it will automatically clear the current contents.

Users can **adjust** the filed in either “Value” or “Label” drop-down box. **Click** the “Classify”  button to **redo** the classification initialization process.

Click the “Set Color”  button, it will automatically jump to a color selection widget to select the color of this label, as shown below:

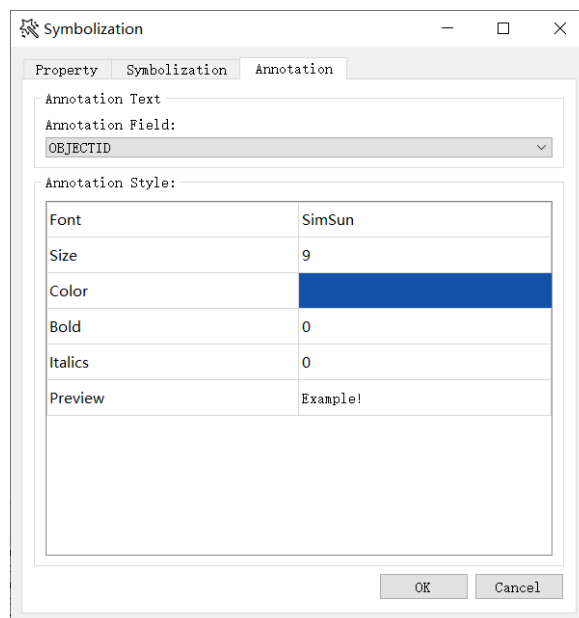


Click the “OK”  button to exit the “Layer Symbolization” interface after all parameter settings are done. It will refresh the display interface and change the layer style based on user’s layer symbolization settings. A sample rendering result is shown as below:



2.1.6.3.Annotation

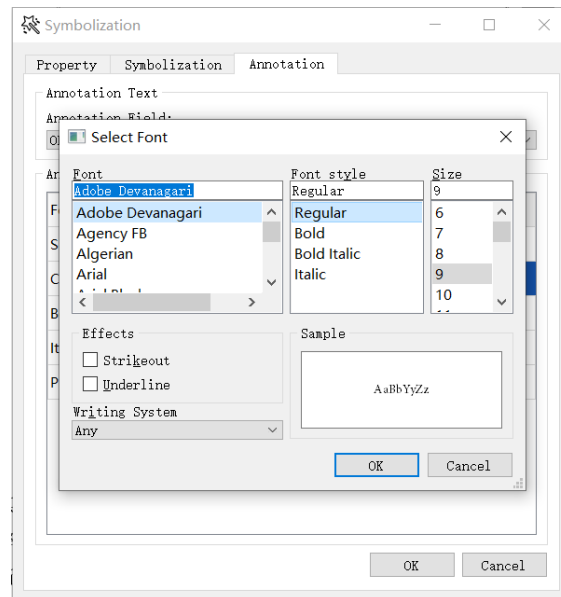
Select “Annotation” to conduct annotation configuration:



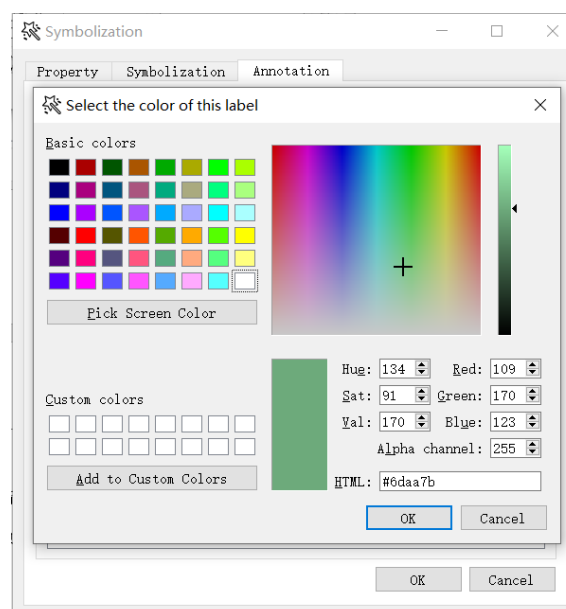
For the “Annotation Field” drop-down box, users can *select* a specific attribute which needs annotation setting.



Users can *configure* annotation styles including Font, Size, Color, Bold, Italics and Preview as provided by VecLI:

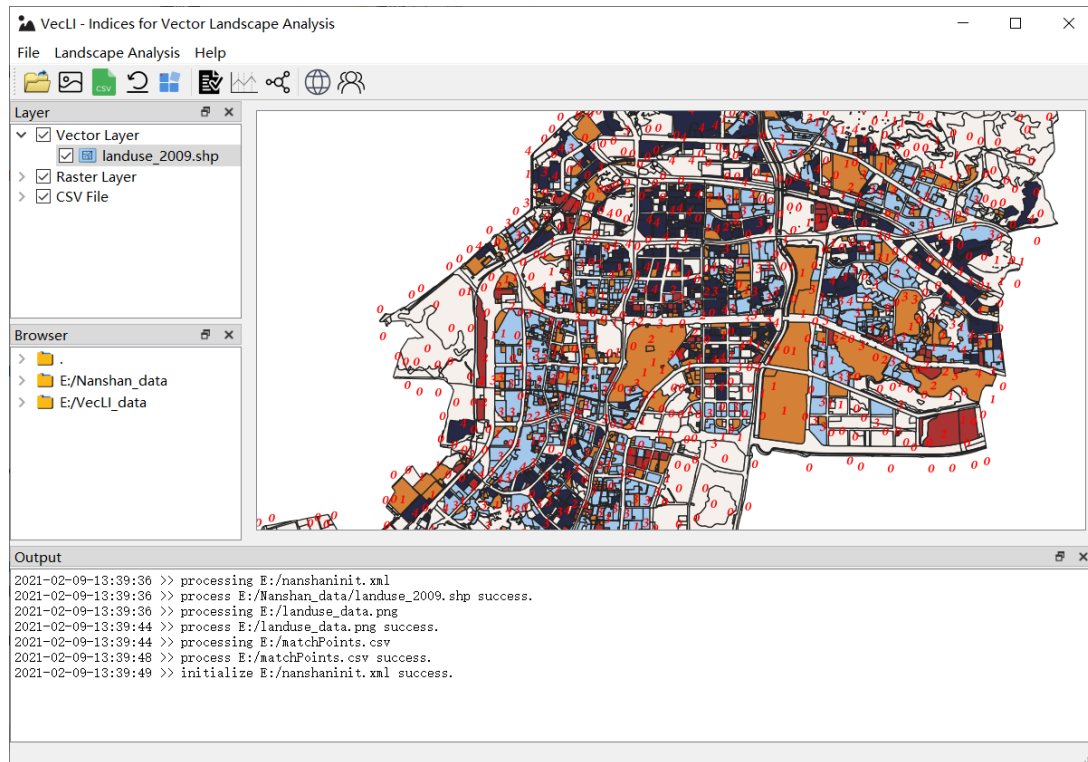


A color selection widget is provided for selecting the annotation color. User can edit the color for annotation by *clicking* the color bar Color, as shown below:



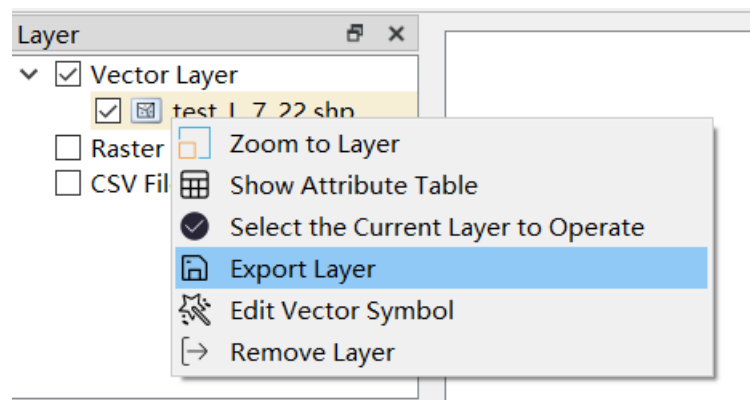
Click the “OK” OK button to exit the “Layer Symbolization” interface after all parameter settings are done. It will refresh the display interface and change the layer style based on user’s layer symbolization settings. A sample rendering result is

shown as below:

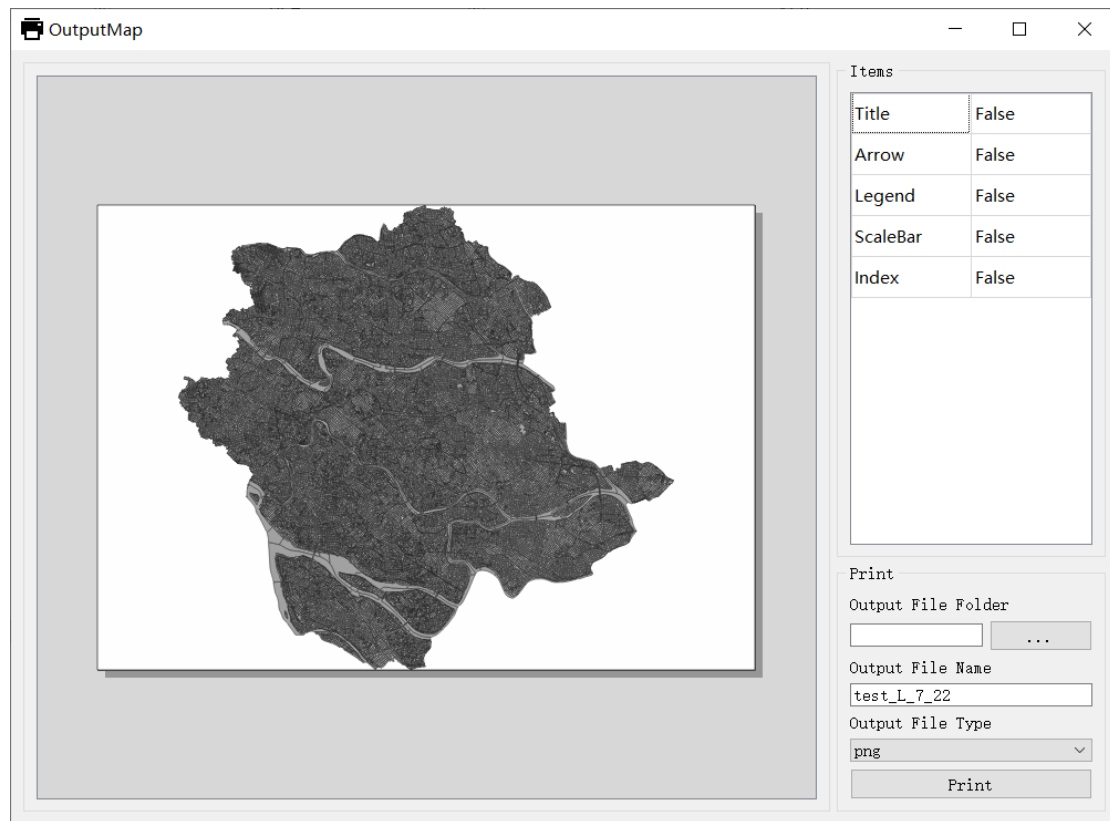


2.1.7. Export Layer

Click the “Export Layer” button to export a customized map for the currently selected data layer (only supports Vector or Raster data layer).



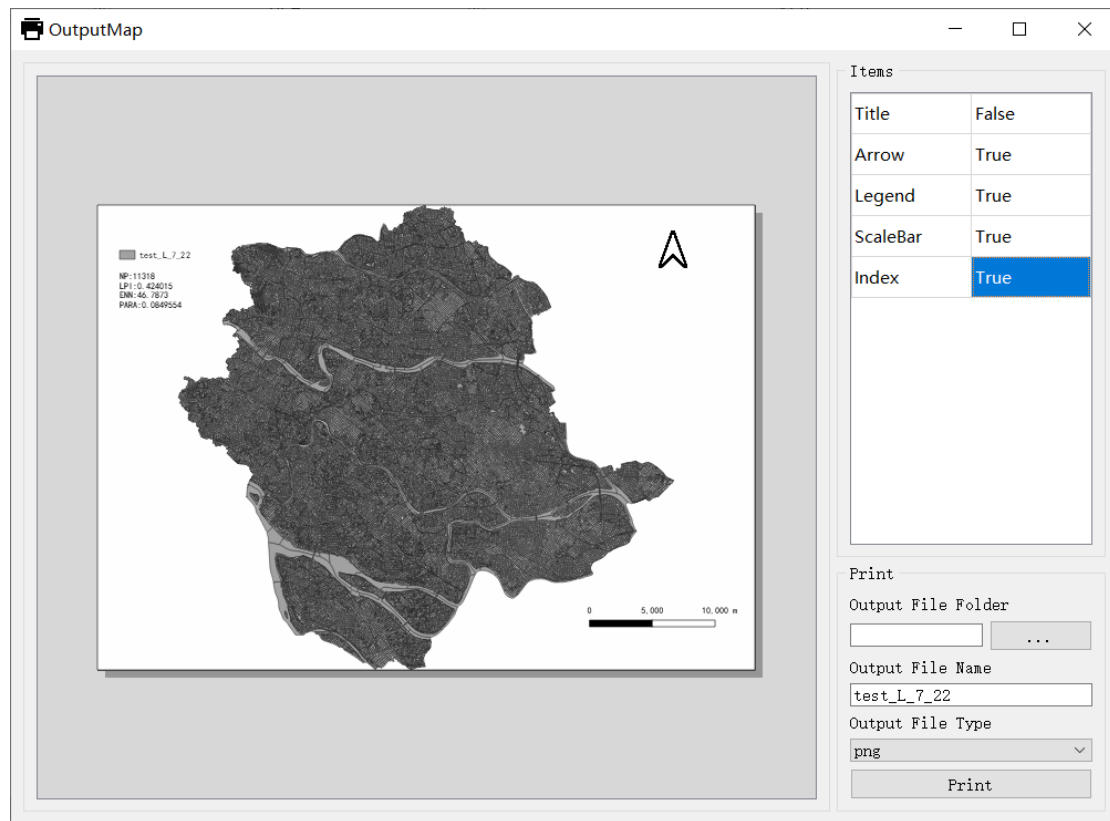
It will automatically jump to a OutputMap Window, as shown in the following figure:



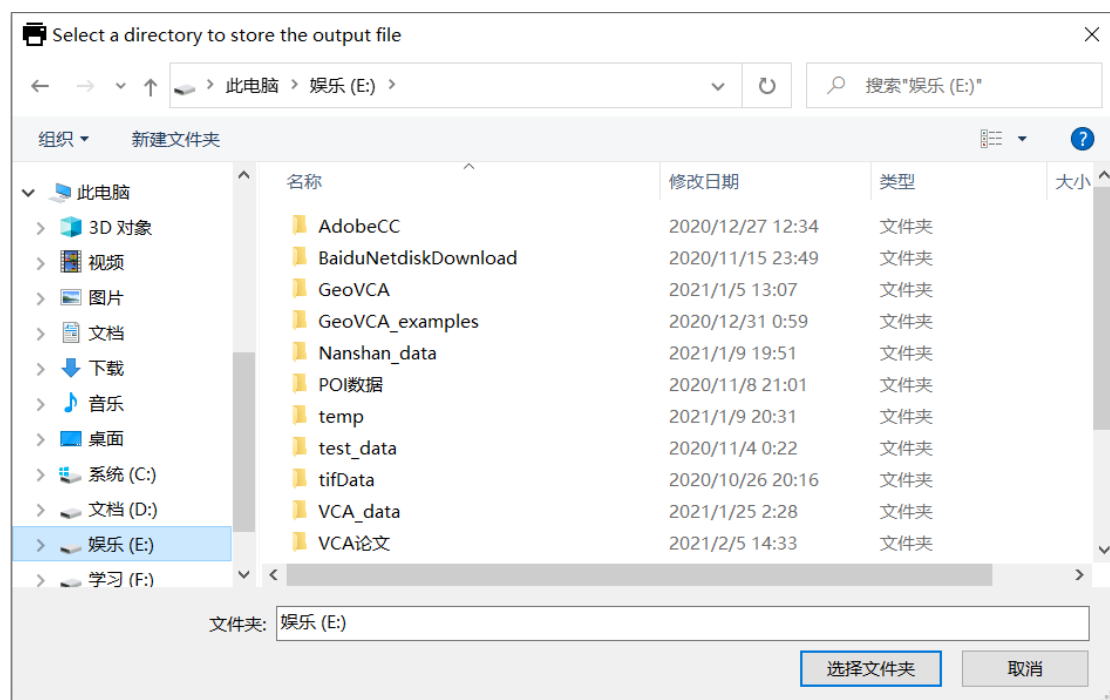
Users can **control** the visible/invisible status of map elements by **double-clicking** the corresponding True/False entry through the top-right Item table, including Title, Arrow, Legend, ScaleBar and Index (vector landscape index table). The Item table is shown as below:

Items	
Title	False
Arrow	True
Legend	True
ScaleBar	True
Index	True

A sample exported map is shown as below:




Users should *specify* the output paths explicitly for the generated map by clicking ... buttons. It will automatically open the Directory Selection Dialog Box as below:



Users are asked to *provide* Output File Name and *determine* Output File Type to

finish the map export. The output file name is determined through the input field of "Output File Name", and the output file type is determined through the "Output File Type" drop-down box.

Output File Name	Output File Type
test_L_7_22	png


Click the "Print"  button to export map as an image file. An

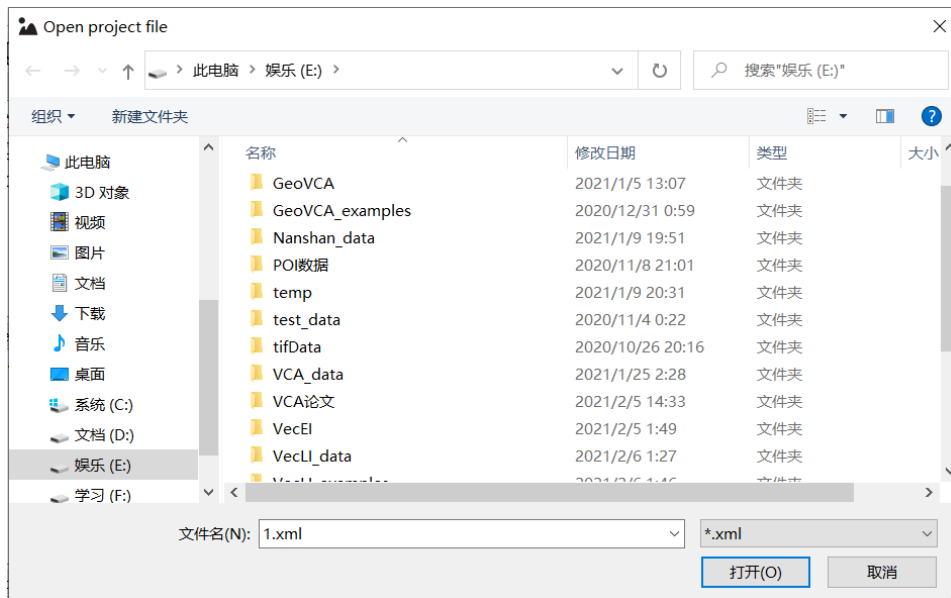
Exception Prompt Dialog Box will be appeared if the print fails,

2.1.8. Remove Layer

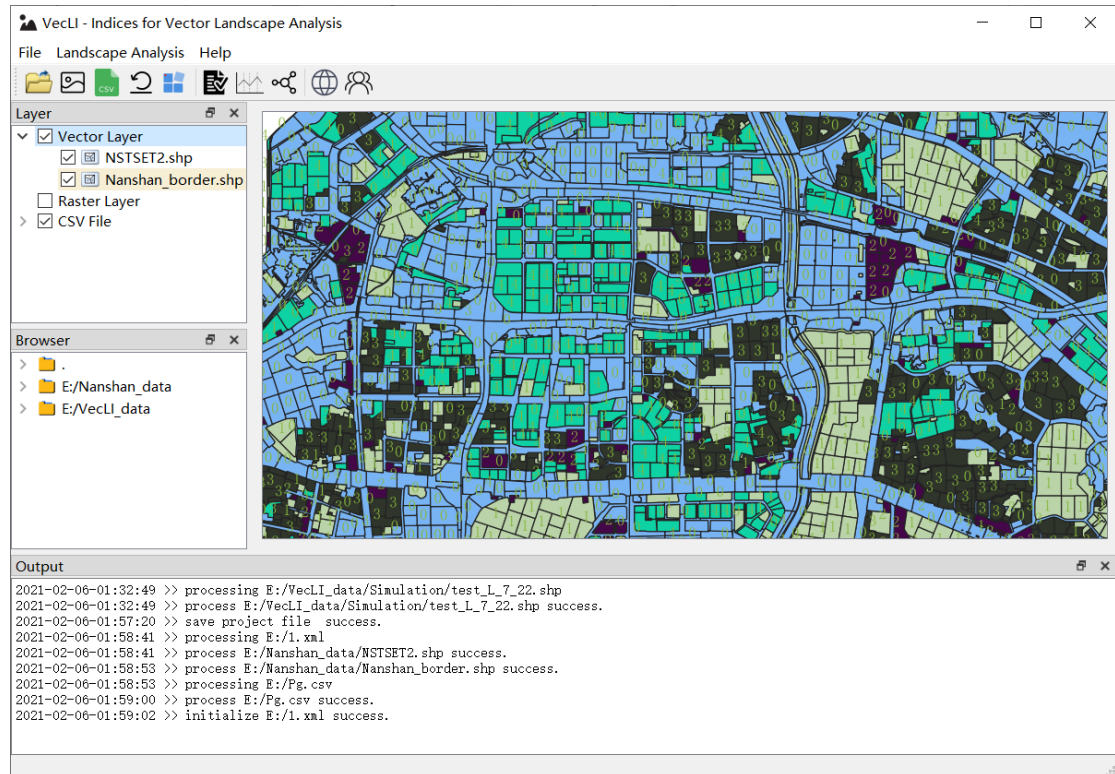
Click the "Remove Layer" button in the GIS operation widget, the selected layer will be removed immediately from the current project.

2.1.9. Open Project File (.xml)


First-Click the "File" in the menu bar and **choose** the "Open Project File", it will automatically jump to the Directory Selection Dialog Box for opening an existing project. Click the toolbar's  button would work in the same way:

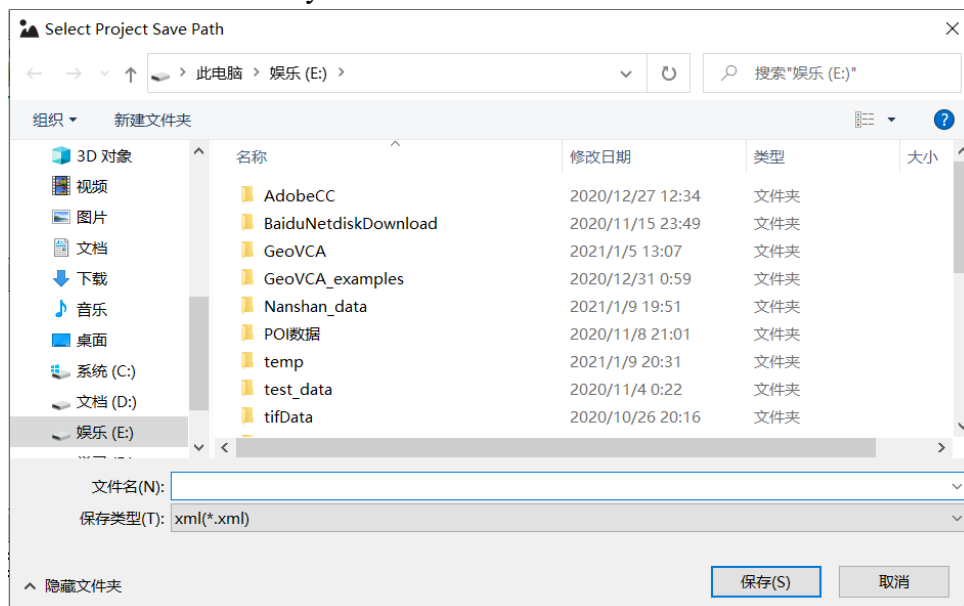


The user interface after opening a project file is as follows:



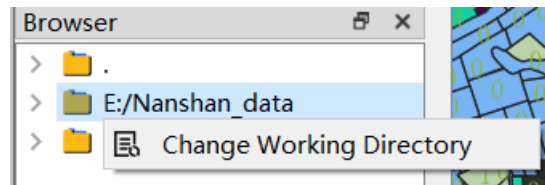
2.1.10. Save Project File (.xml)

First-Click the “File” in the menu bar and **choose** the “Save Project File” option, it will automatically jump to the Directory Selection Dialog Box to save the currently operating project in user’s specified directory path. **Click** the toolbar’s  button would work in the same way:

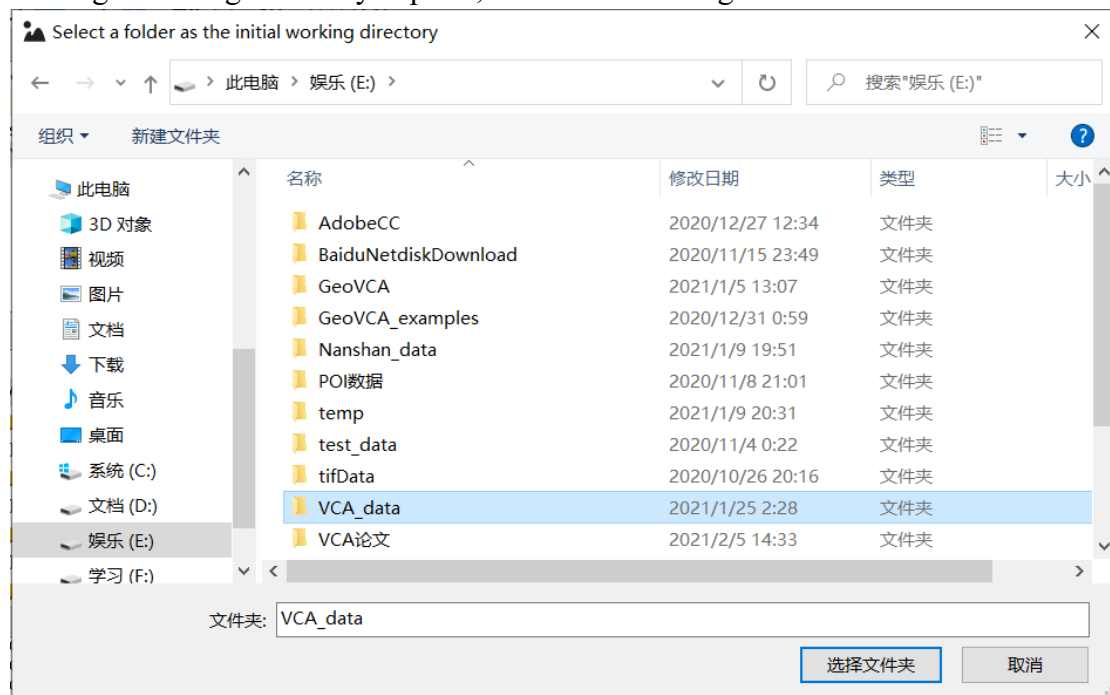


2.1.11.Change Working Directory

Users can change the working directory by **right-clicking** the Current Directory Browser Panel, which is shown as below:

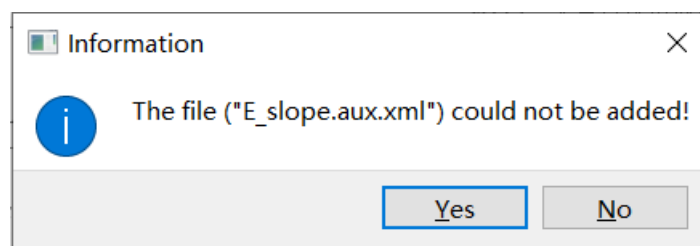


It will automatically open a Directory Selection Dialog Box after **clicking** the “Change Working Directory” option, as shown in the figure below:



2.1.12.Import Files from Current Directory Browser Panel

Double-click any file shown in the Current Directory Browser Panel, users can quickly import the corresponding data into the system. Exception Prompt Dialog Box will pop up if the chosen file has an invalid format:



Note: Supported formats are only among vector files, raster files and CSV files.

3. Vector-based Landscape Index Calculation and Analysis Function

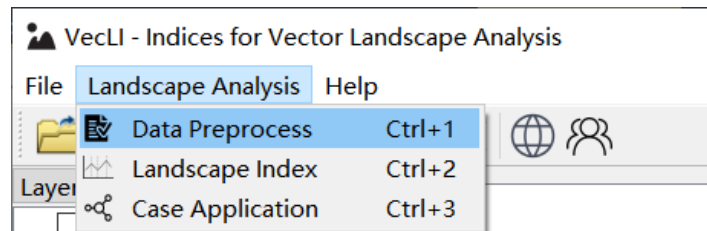
3.1. Vector Data Preprocessing

This module is provided to calculate the center of coordinates, perimeter and area of a parcel for vector data pre-processing to ensure the accuracy of calculating the landscape indices under any situations.

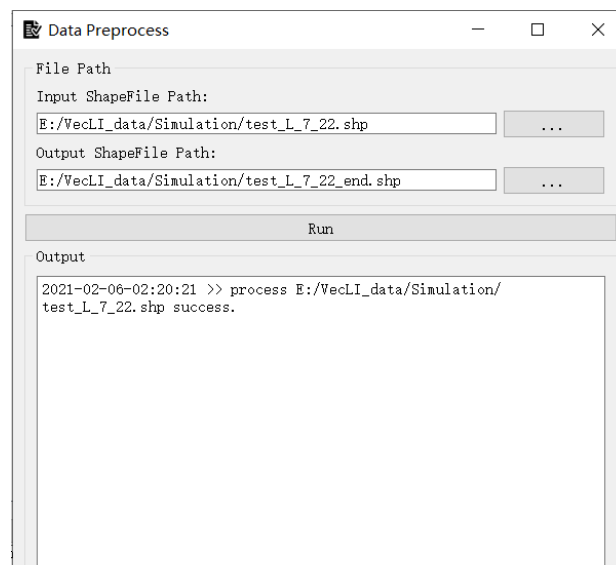
Considering the complexity of vector data structures, the authors have enhanced the compatibility of data and algorithms within VecLI to accommodate land-parcel data with missing or incorrect spatial or attribute information.

3.1.1. Features

First-Click the “Landscape Analysis” in the menu bar and choose the “Data Preprocessing”, it will automatically jump to the Data Preprocess Window.




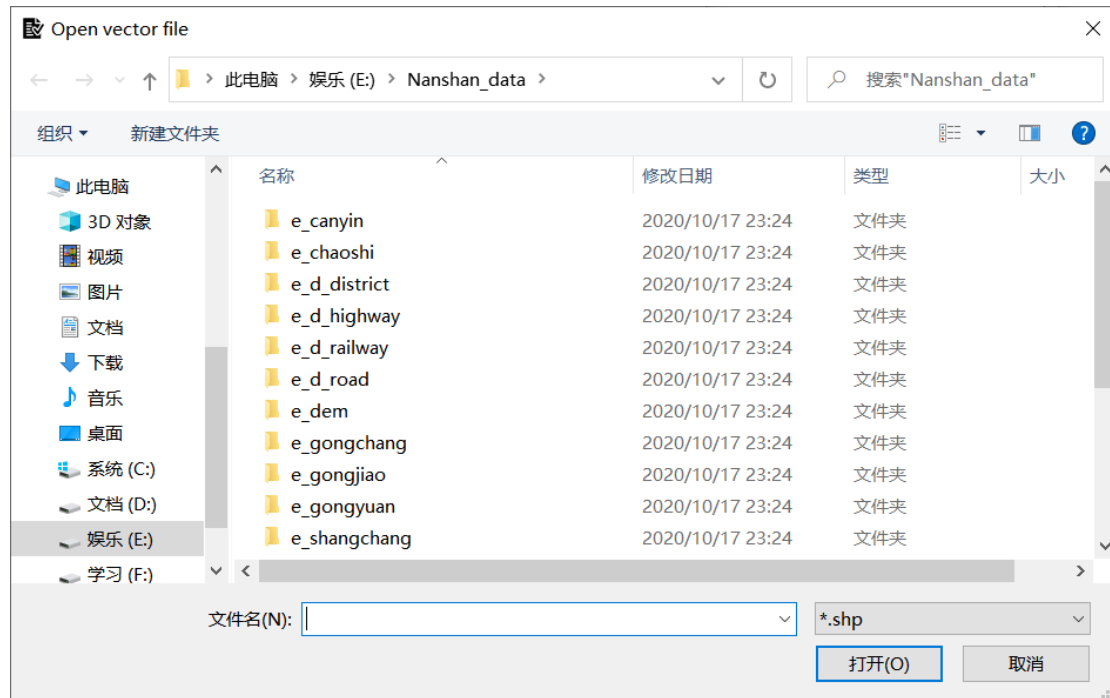
Click the toolbar's  button would work in the same way:



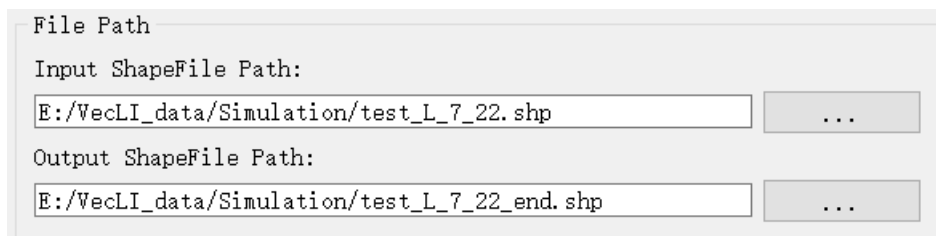
3.1.2. Parameter Settings


Users should *select* the file path first. By default, the system will specify vector file that was already imported and selected for data preprocessing.

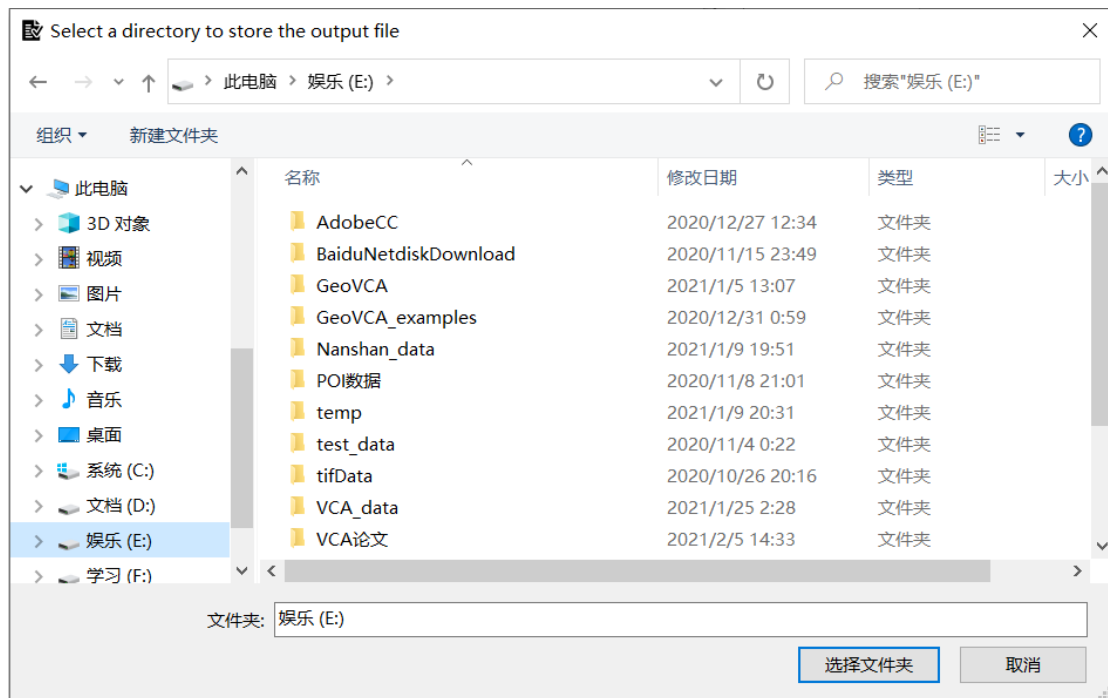
Users can *specify* other vector files as input by *clicking*  button to open the Directory Selection Dialog Box.



The directory to which the input vector file belongs would be set as the output path, and the output file would be automatically named after the original file with a suffix "_end". A sample case is shown as below:



Users are allowed to *specify* other locations as output directory by *clicking*  button to open the Directory Selection Dialog Box. The new output directory would take place the default setting and the output file would be automatically named after the original file with a suffix "_end".

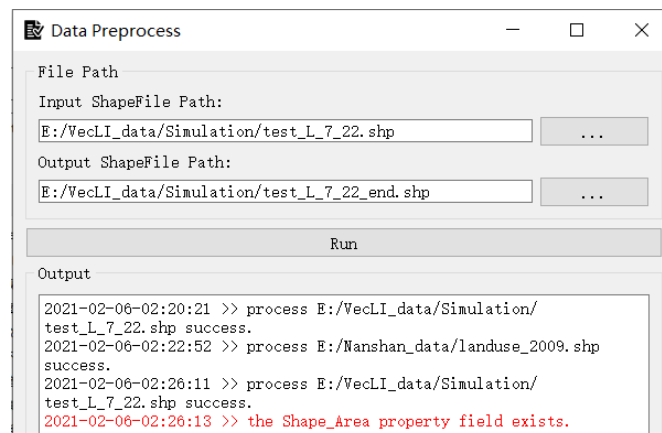


Click the “Run” button to run the Data Preprocessing module with the above parameter setting.

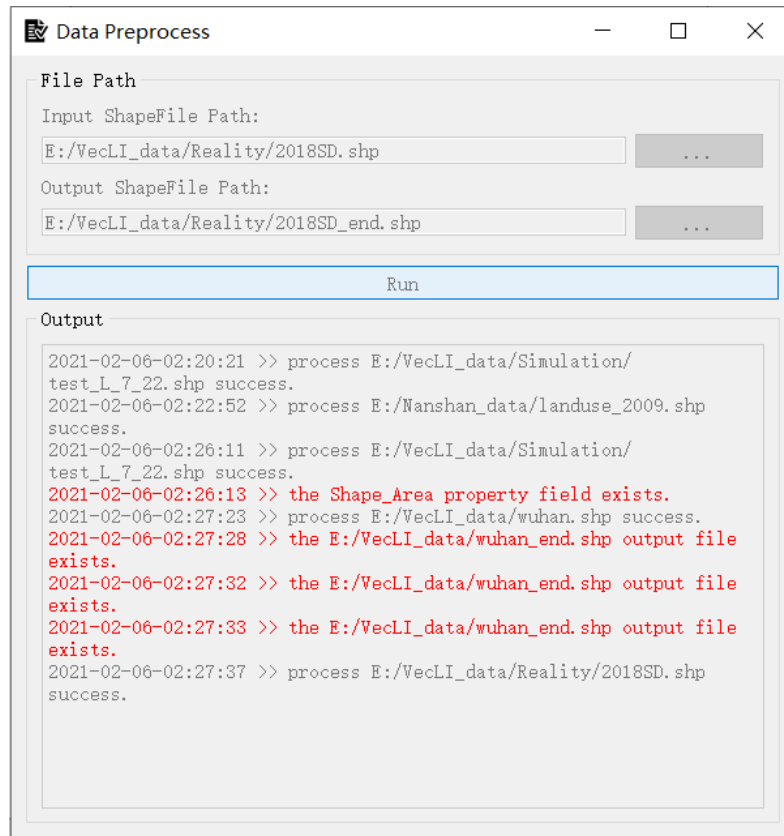


Four new attributes, including 1). Parcel Area, 2). Parcel Perimeter, 3). Parcel Center Abscissa, and 4). Parcel Center Ordinate, are computed and wrote into the output vector file.

If there is a problem with the vector file field, a warning prompt will appear in the LOG output panel:



The data preprocessing module will be temporarily locked while the program is running. A running sample is shown as below:

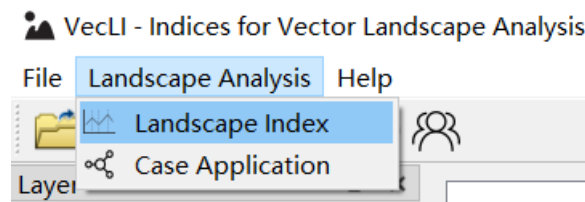



3.2. Vector-based Landscape Index Calculation

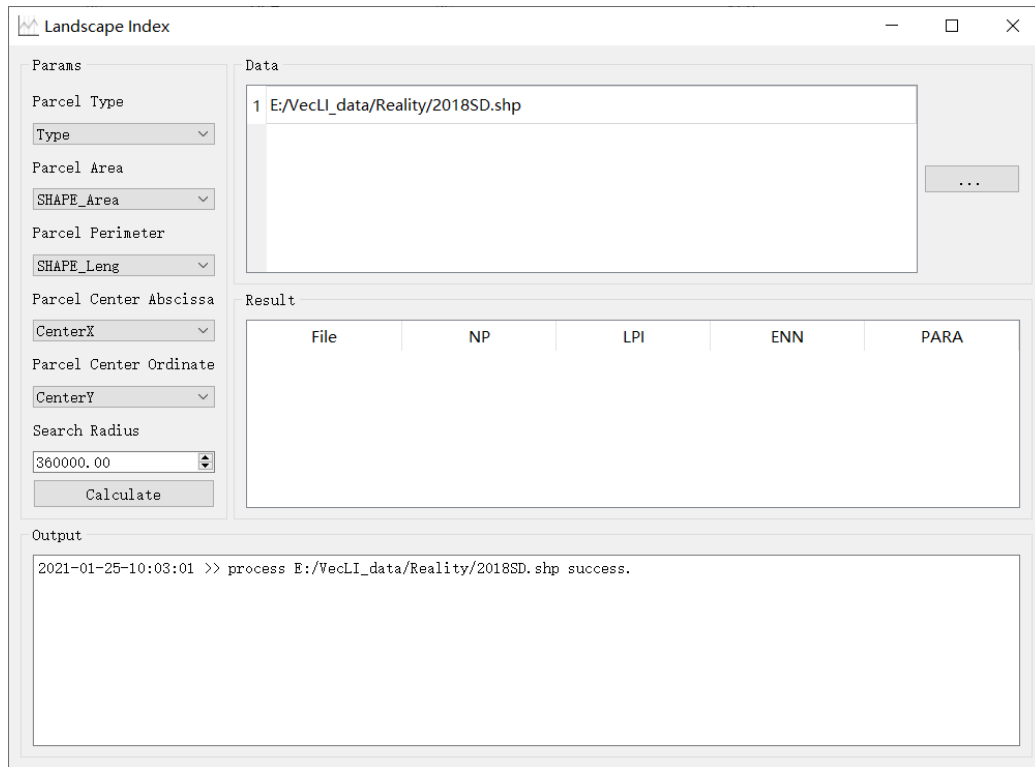
This module is designed for calculating the similarity of landscape pattern between two different vector files (normally CA simulation result and actual data).

3.2.1. Features


First-Click the “Landscape Analysis” in the menu bar and **choose** the “Landscape Analysis”, it will automatically jump to the Landscape Index Window.

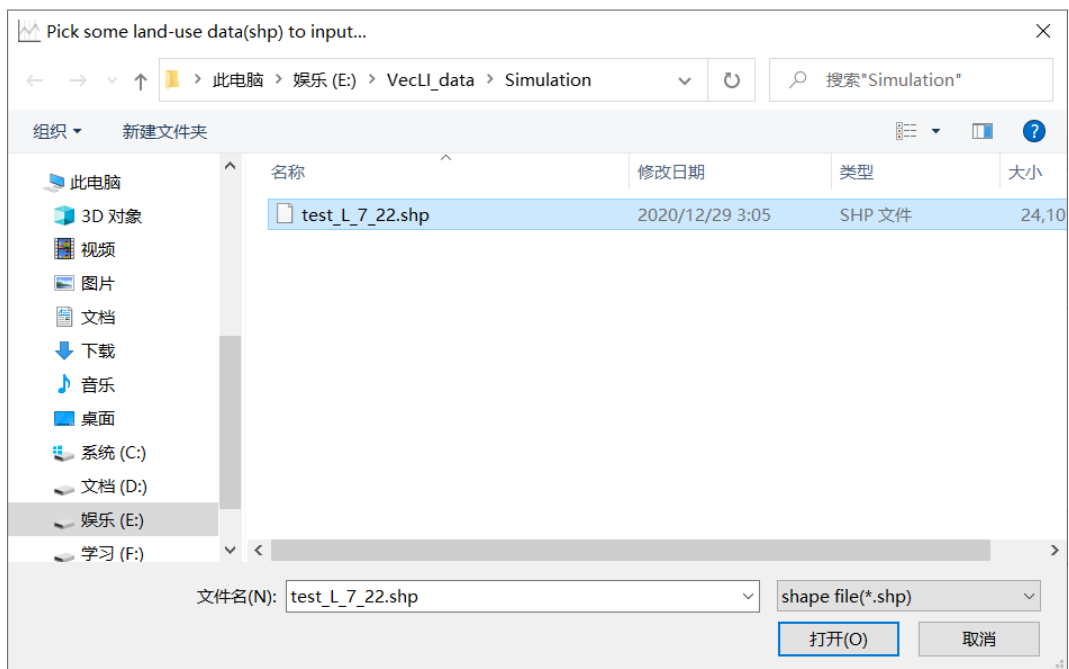


Click the toolbar’s  button would work in the same way:



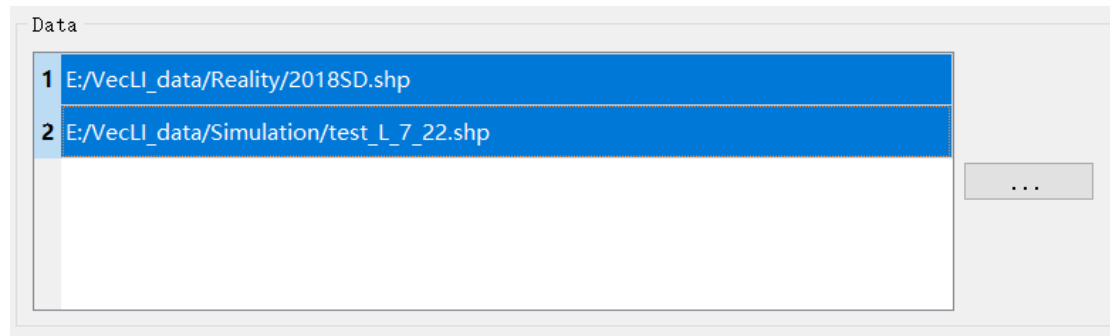
3.2.2. Import Files

Click the “Vector File Import” button , it will automatically jump to the Directory Selection Dialog Box for vector file selection (vector-based land-parcel files from different times):



The module will automatically list the paths of vector files after the vector files have been chosen. By default, the system will import all the vector data shown in the Data Management Panel.

Users can *delete* undesired land-use data by pressing keyboard's delete button for the selected rows:



3.2.3. Parameter Settings

Users are asked to *set* necessary parameters for vector-based landscape index calculation. Parameters include: 1). Parcel Type; 2). Parcel Area; 3). Parcel perimeter; 4). Parcel Center Abscissa; 5). Parcel Center Ordinate; and 6). Search Radius.

The first five parameters are *set* through the parameter setting drop-down box, in which the drop-down box for field selection is shown as below:

Params

Parcel Type
Type ▼

Parcel Area
SHAPE_Area ▼

Parcel Perimeter
SHAPE_Leng ▼

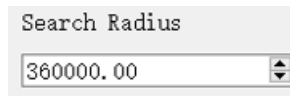
Parcel Center Abscissa
CenterX ▼

Parcel Center Ordinate
CenterY ▼

Search Radius
360000.00 ▲▼

Calculate

“Search Radius”, the sixth parameter, should be manually *entered* by users:



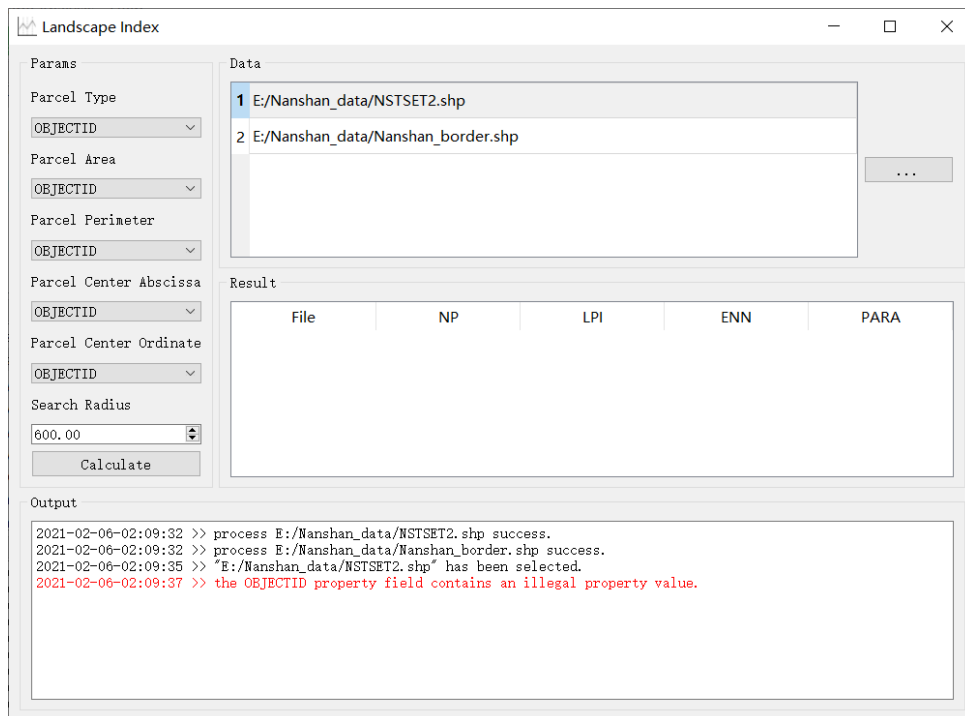
Search Radius

360000.00

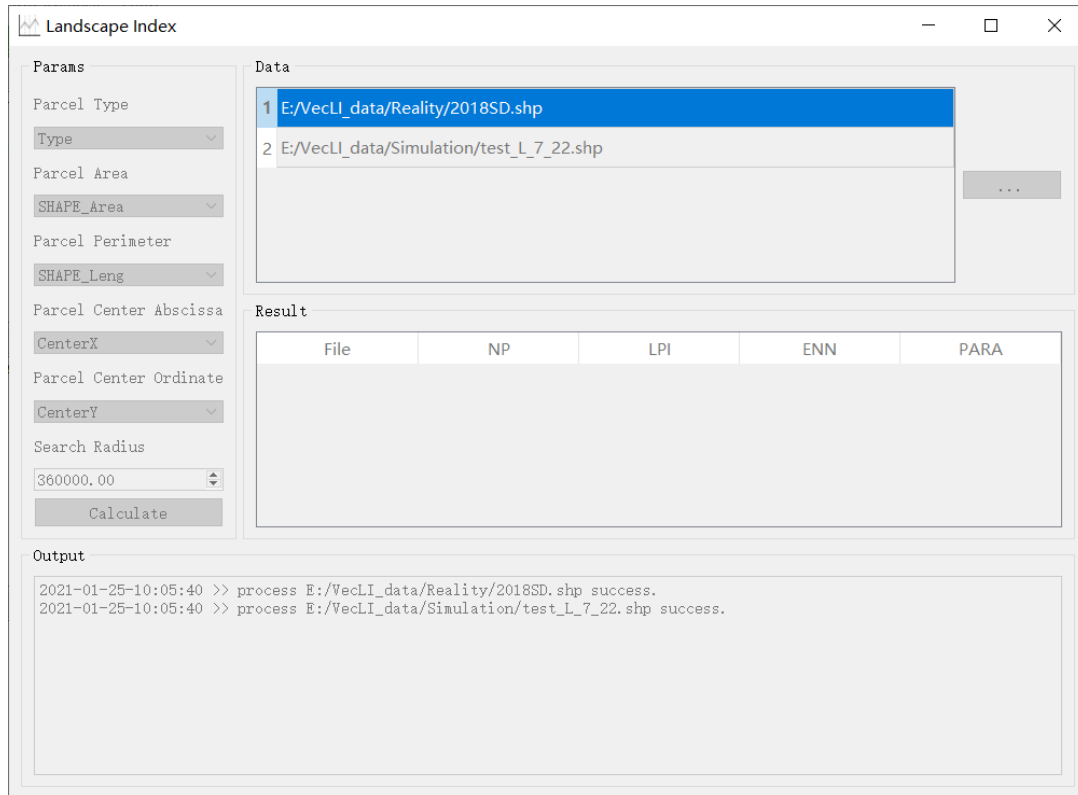
3.2.4. Vector-based Landscape Index Calculation

Click the “Calculate”  button to start the vector-based landscape index calculation after all the parameter settings are done.

Noted that exceptions will throw out in the LOG output panel to notify the cause of failure:



The vector-based landscape index calculation module will be temporarily locked while the program is running. A running sample is shown as below:



The system will immediately display the calculation result. A sample calculation result is shown as below:

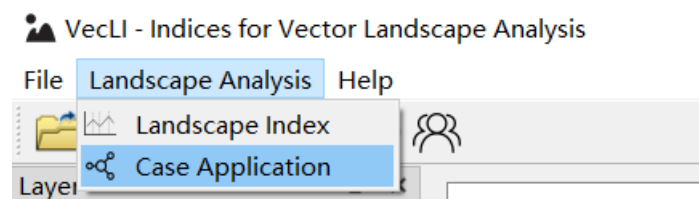
File	NP	LPI	ENN	PARA
E:/VecLI_data/Rea...	13747	0.419146	51.8826	0.111365

3.3. Automatically Mining the Optimal Search Radius

This module can automatically calculate the optimal search radius based on the imported vector files.

3.3.1. Features

First-Click the “Analysis” in the menu bar and **choose** the “Scene Application”, it will automatically jump to the Case Application Window:



Click the toolbar's



button would work in the same way:

3.3.2. Import Files

First, users should **select** a vector file for processing. Options in the “Input File” drop-down box include all the vector files that have been imported into the system. The drop-down box for selecting vector files is shown as below:

3.3.3. Parameter Settings

Users are asked to **set** necessary parameters for vector-based landscape index calculation. Parameters include: 1). Parcel Type; 2). Parcel Area; 3). Parcel perimeter; 4). Parcel Center Abscissa; 5). Parcel Center Ordinate; 6). Search Radius; and 7). Traversal Times.

The first five parameters are **set** through the parameter setting drop-down box.

Basic Params

Input File
E:/VecLI_data/Reality/2018SD.shp ▾

Parcel Type
DLMC ▾

Parcel Area
DLMC ▾

Parcel Perimeter
DLMC ▾

Parcel Center Abscissa
DLMC ▾

Parcel Center Ordinate
DLMC ▾

Search Radius
360000.00 ▴ ▾

Traversal Times
3 ▴ ▾

Calculate

Search radius, the sixth parameter, sets the initial radius value for optimal search radius mining. The parameter has to be manually *entered* by users.

Search Radius

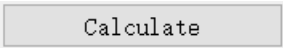
360000.00 ▴ ▾

Traversal Times, the seventh parameter, is used to determine the fuzzy search range for the optimal radius mining. The parameter has to be manually entered by users.

Traversal Times

3 ▴ ▾

3.3.4. Optimal Search Radius Mining

Click the “Calculate”  button to start the optimal search radius mining after all the parameter settings are done.

The optimal search radius mining module will be temporarily locked while the program is running. A running sample is shown as below:

Case Application

Basic Params

Input File: E:/VecLI_data/Reality/2018SD.shp

Parcel Type: Type

Parcel Area: SHAPE_Area

Parcel Perimeter: SHAPE_Leng

Parcel Center Abscissa: CenterX

Parcel Center Ordinate: CenterY

Search Radius: 360000.00

Traversal Times: 3

Calculate

Result

Radius	NP	LPI	ENN	PARA
--------	----	-----	-----	------

The system will immediately display the calculation result. A sample calculation result is shown as below:

Case Application

Basic Params

Input File: E:/VecLI_data/Simulation/test_L_7_22.shp

Parcel Type: Type_id

Parcel Area: Shape_Area

Parcel Perimeter: Shape_Leng

Parcel Center Abscissa: centerX

Parcel Center Ordinate: centerY

Search Radius: 600.00

Traversal Times: 3

Calculate

Result

	Radius	NP	LPI	ENN	PARA
1	330000	11488	0.4213...	47.3596	0.0841...
2	340000	11422	0.42138	46.9493	0.0840...
3	350000	11351	0.4221...	46.7939	0.0846...
4	360000	11318	0.4240...	46.7873	0.0849...
5	370000	11244	0.4251...	46.8004	0.0851...
6	380000	11173	0.4257...	46.6369	0.0856...
7	390000	11126	0.4262...	46.1466	0.0864...

4. Copyright and Contact

If you encounter problems in use, please contact us in time.

VecLI: Vector-based Landscape Index Calculation and Analysis

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